

# Acid Base 1

You'll be asked to do two things: interpret a blood gas (which comes later) and decide what to do next. We first handle "what to do next," the potential diagnoses that might be encountered and how to spot them on a vignette.

The first step is to determine what the primary disturbance is. It's discussed in greater detail in gas interpretation, but basically  $< 7.4$  is acidic while  $> 7.4$  is basic. Then use the  $\text{CO}_2$  (with a cutoff of 40) to separate into respiratory or metabolic.

## Respiratory Acidosis

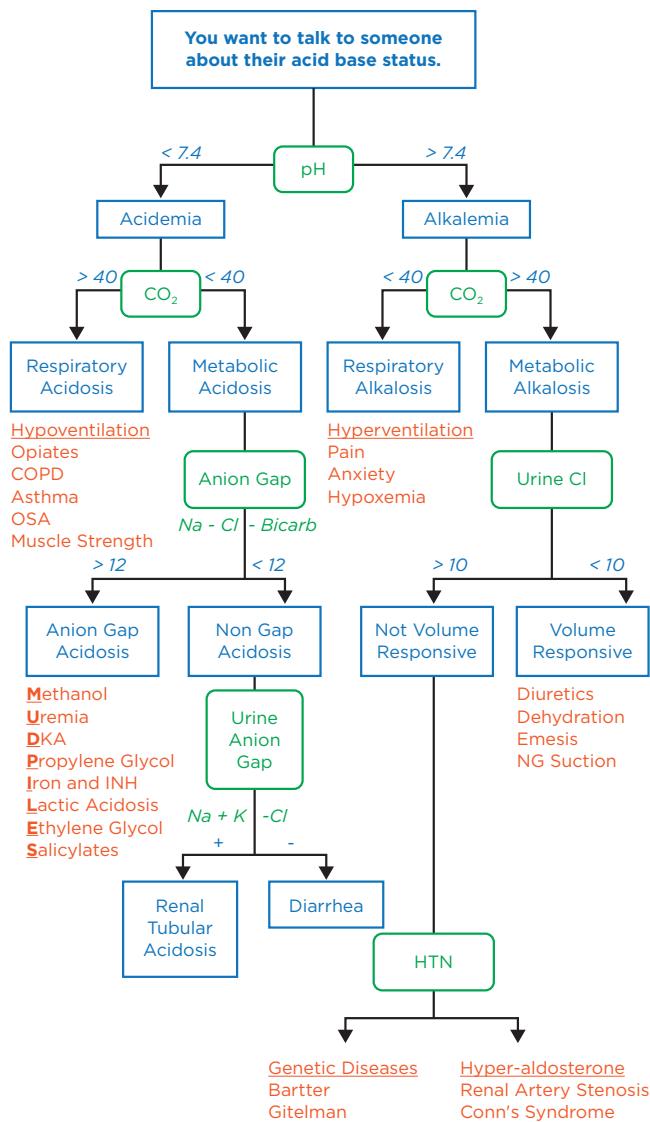
This is a product of hypoventilation. The less ventilation the more  $\text{CO}_2$  will accumulate. Whether it's a low tidal volume (COPD) or a low respiratory rate (opiate overdose), if either falls the  $\text{CO}_2$  rises. Look for things like wheezing (Obstructive Lung Disease), obesity (OSA), cyanosis and pinpoint pupils ( opiates), or signs of muscle weakness (like paralysis from Guillain–Barré)

## Respiratory Alkalosis

Conversely, respiratory alkalosis is from hyperventilation. Very few things will do that as a primary disturbance. It'll either be pain, anxiety or hypoxemia. Lots of things cause hypoxemia (pneumonia, PE, ARDS) so the patient can get complex, but in terms of acid-base respiratory alkalosis means hyperventilation.

## Metabolic Alkalosis

The only thing that causes this is a high aldosterone. The decision is if the person is volume responsive – that is, will giving him/her volume improve their alkalosis? This is done in one of two ways: using the history to say he/she is volume down and give fluids, then recheck the bicarb OR by checking the **urine chloride**. The test loves the urine chloride. If it's low ( $< 10$ ) the patient is salt-sensitive, or volume responsive, and giving him/her volume will improve his/her condition. Look for the use of diuretics, emesis or NG suction, or another reason for them to be dehydrated (looking for insensible water losses like sepsis, fever, tachypnea, or tachycardia).



**Figure 1.1**

TEST	WHEN TO USE IT
pH	Start here
$\text{pCO}_2$	After pH to get primary disturbance
Anion Gap	Metabolic Acidosis
Urine Anion Gap	Non-Gap Acidosis
Urine Chloride	Metabolic Alkalosis

**Table 1.1**

If the Urine Chloride is high (**> 10**) it's a condition that has nothing to do with volume. It's then time to assess for the presence of **hypertension**.

If there is **+ HTN**, consider diseases of too much aldosterone; inappropriate elevations in aldosterone levels. It's most likely to be renal artery stenosis or Conn's syndrome (primary hyperaldosteronism). Keep in mind that the aldosterone was up in volume depletion to keep the pressure up. In this case it's up inappropriately, so it causes a rise in blood pressure.

If the patient is **- HTN**, think of Bartter and Gitelman syndromes - genetic, always present forms of Furosemide and HCTZ, respectively.

## Metabolic Acidosis

Metabolic Acidosis is the hardest to handle; it's the most complex by far in gas interpretation. But it's pretty easy to get the answer right when trying to make a diagnosis based on the clinical scenario.

First, calculate the **anion gap** (Na - Cl - Bicarb). A normal gap is 12, or Albumin x 3. If greater, there's an anion gap acidosis, which can be reminded by a number of mnemonics. We've chosen MUDPILES in this section (just don't forget about Toluene). In an **anion gap metabolic acidosis** the diagnosis is made by the rest of clinical picture. Highlights of the ones you must know are to the right.

For **non-gap acidosis** the next step is the **urine anion gap**. The urine anion gap is calculated from similar but not the same electrolytes as the regular anion gap (frustrating), so be careful. If **positive** the answer is renal tubular acidosis. If **negative** the answer is diarrhea.

$UCl < 10$  = Volume Responsive

$UCl > 10$  = Not Volume Responsive

$UCl > 10$  and HTN = Inappropriate Aldosterone

$UCl > 10$  and no HTN = genetic diseases

**ANION GAP:**  $Na - Cl - \text{Bicarb}$   
(NO POTASSIUM)

HIGHLIGHTS TO MUDPILES DIAGNOSES	
DKA	Diabetic who is acidotic. Look for ketones. Treat with insulin, fluids, and replete potassium
Methanol	Homemade liquor (moonshine), causes blindness, no cure
Ethylene Glycol	Crystals in the urine, urine turns color under Wood's Lamp. Give either ethanol or fomepizole
Lactic Acidosis	Either Metformin + Acute Kidney Injury or... Patient in shock (fix the shock)

Table 1.2

**URINE ANION GAP:**  $Na + K - Cl$   
(No Bicarb)